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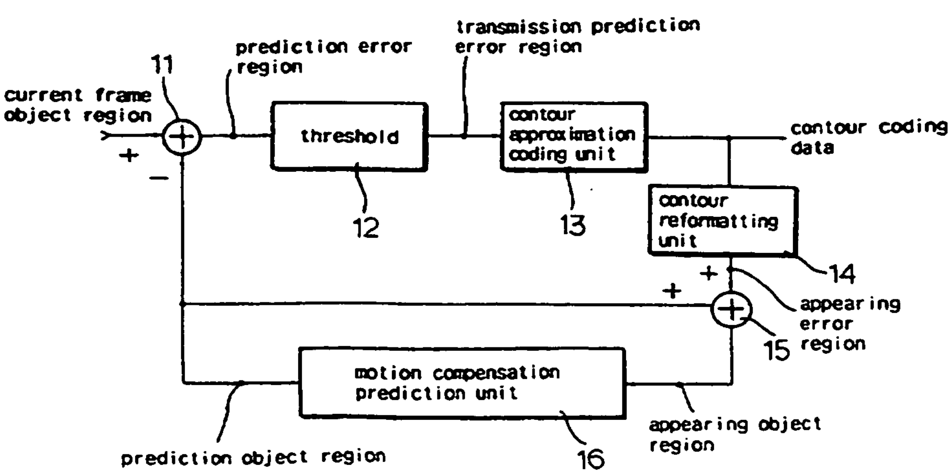
(54) Shape information reduction apparatus

(57) Shape information reduction apparatus includes a motion compensation prediction unit 16 for predicting shape information of a current frame using shape information of a previous frame and motion information of a current frame. A subtracting unit 11 subtracts shape information motion-compensation-predicted by the motion compensation prediction unit 16 and a current motion region and computes an isolated prediction error region. A threshold operation unit 12 performs a threshold operation and determines whether to transmit or block information. A contour approximation coding unit 13 predicts a contour of a predicted error region and reduction-codes and transmits the shape information. A contour reformatting unit 14 reformats the contour into an isolated prediction error region. A combining unit 15 combines the isolated prediction error region and a scale information on movement compensation for a predicted current frame.

FIG. 5



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1A
(Conventional Art)

FIG. 1B
(Conventional Art)

FIG. 1C
(Conventional Art)

FIG. 1D
(Conventional Art)

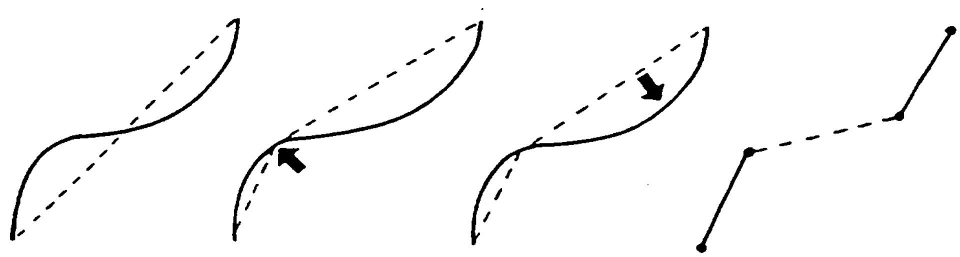


FIG. 2
(Conventional Art)

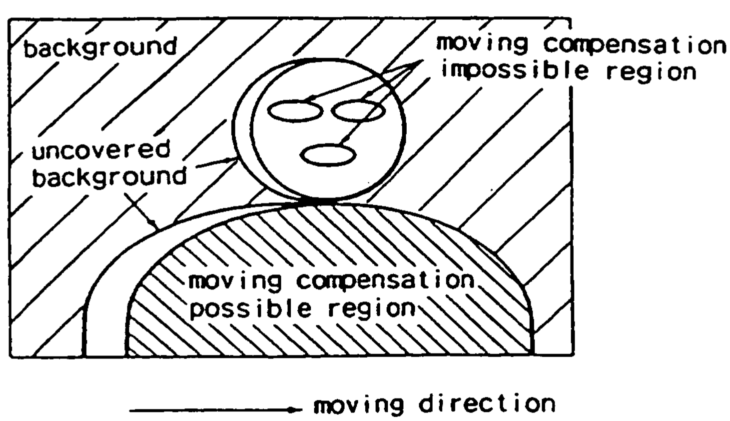


FIG. 3
(Conventional Art)

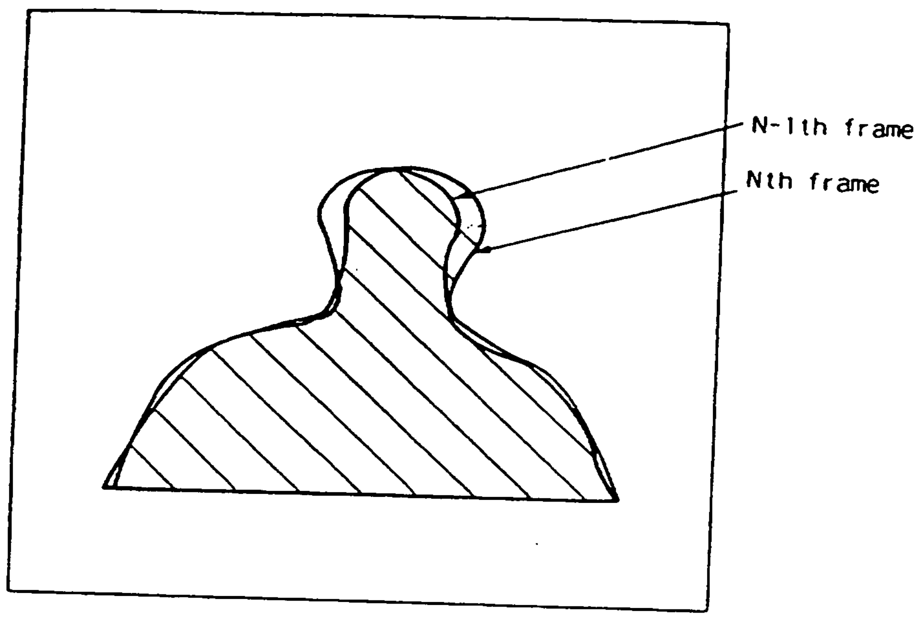


FIG. 4
(Conventional Art)

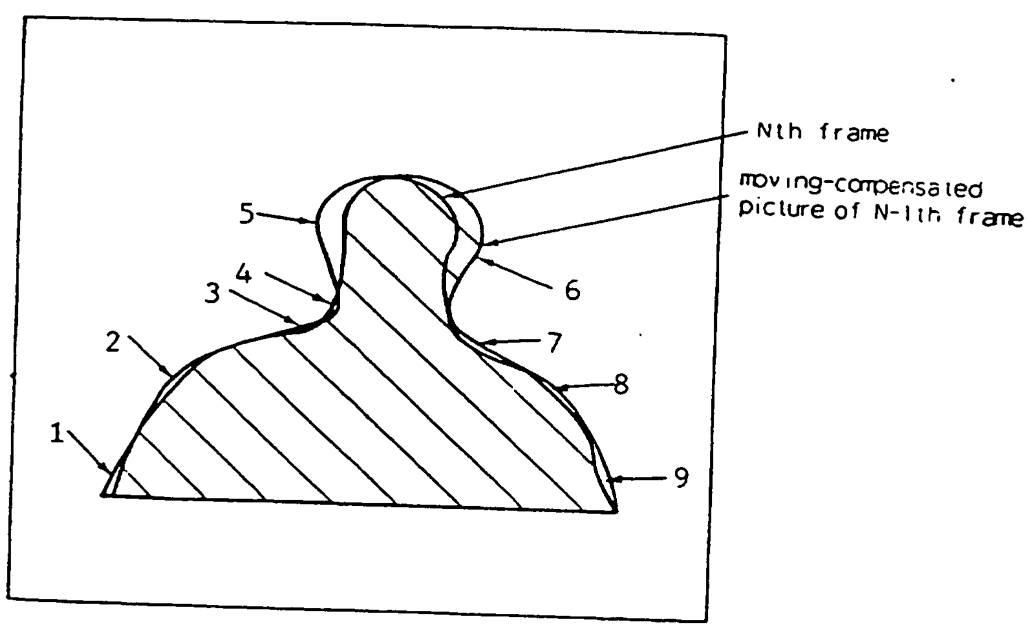
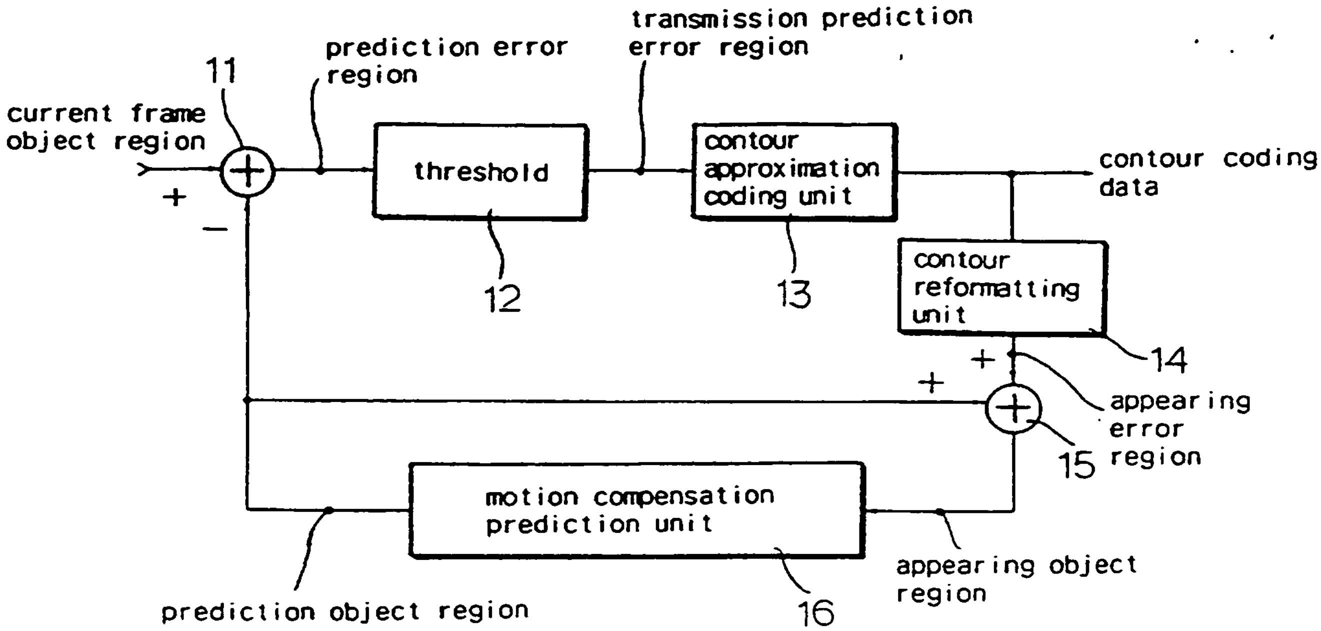
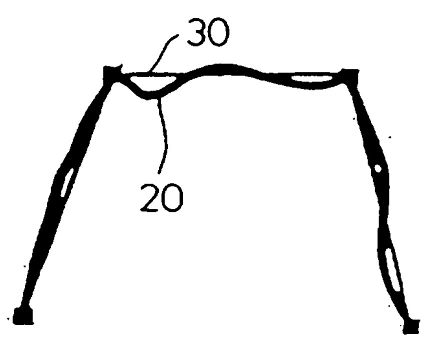


FIG. 5



current frame object region
+
−
11
prediction error region
threshold
12
transmission prediction error region
contour approximation coding unit
13
contour coding data
contour reformatting unit
14
+
+
15
appearing error region
motion compensation prediction unit
16
prediction object region
appearing object region

FIG. 6A



30
20

FIG. 6B

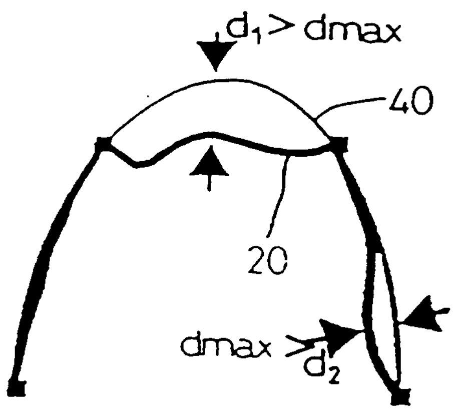


FIG. 6C

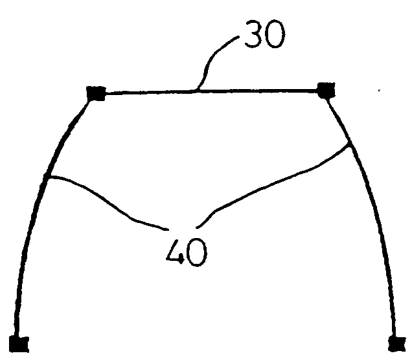


FIG. 7

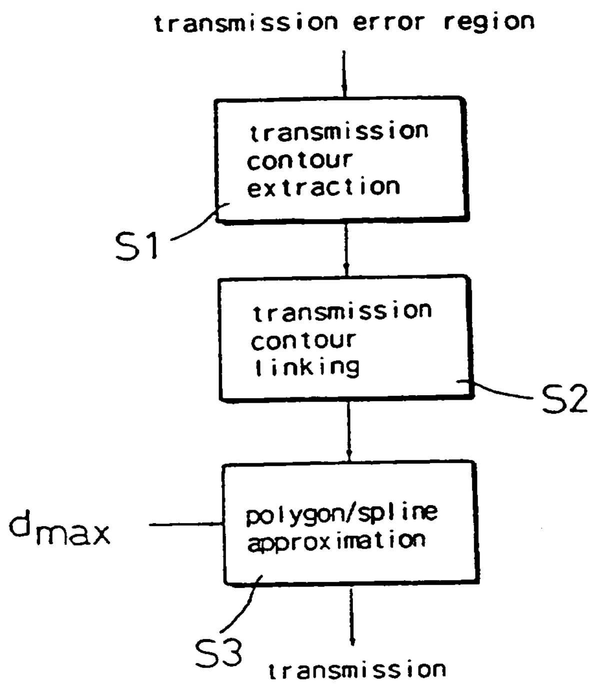


FIG. 8A

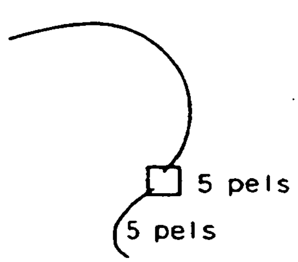


FIG. 8B

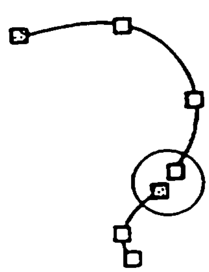


FIG. 8C

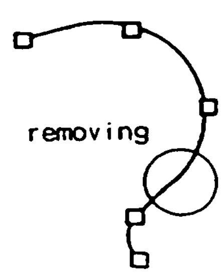


FIG. 9A

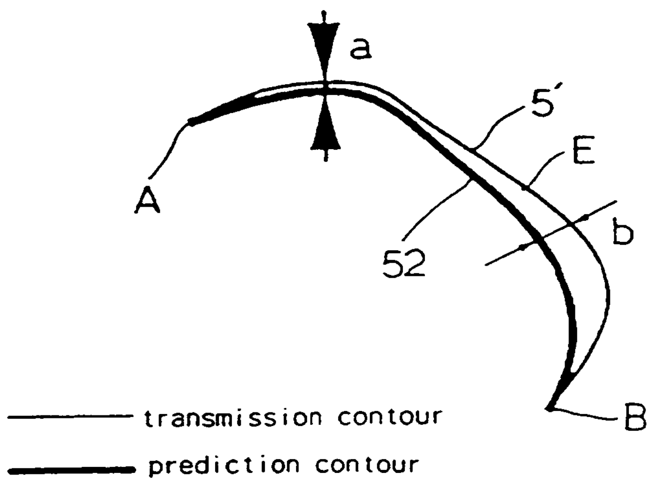


FIG. 9B

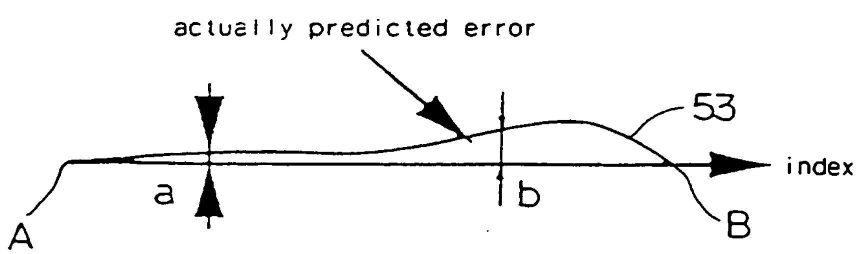


FIG. 9C

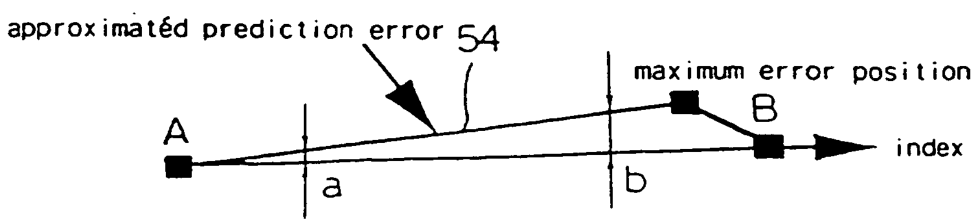
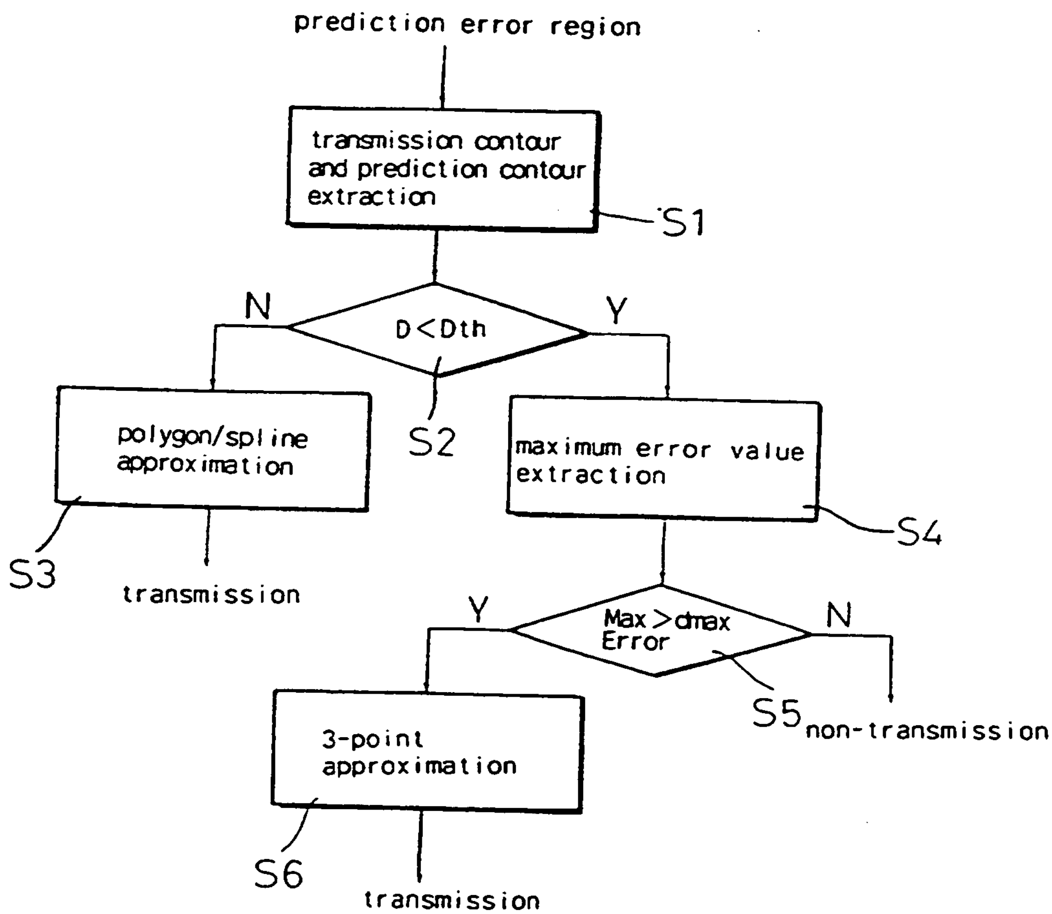


FIG. 10



prediction error region
transmission contour and prediction contour extraction
S1
N
D<Dth
Y
S2
polygon/spline approximation
S3
transmission
maximum error value extraction
S4
Y
Max Error >dmax
N
S5
non-transmission
3-point approximation
S6
transmission

FIG. 11

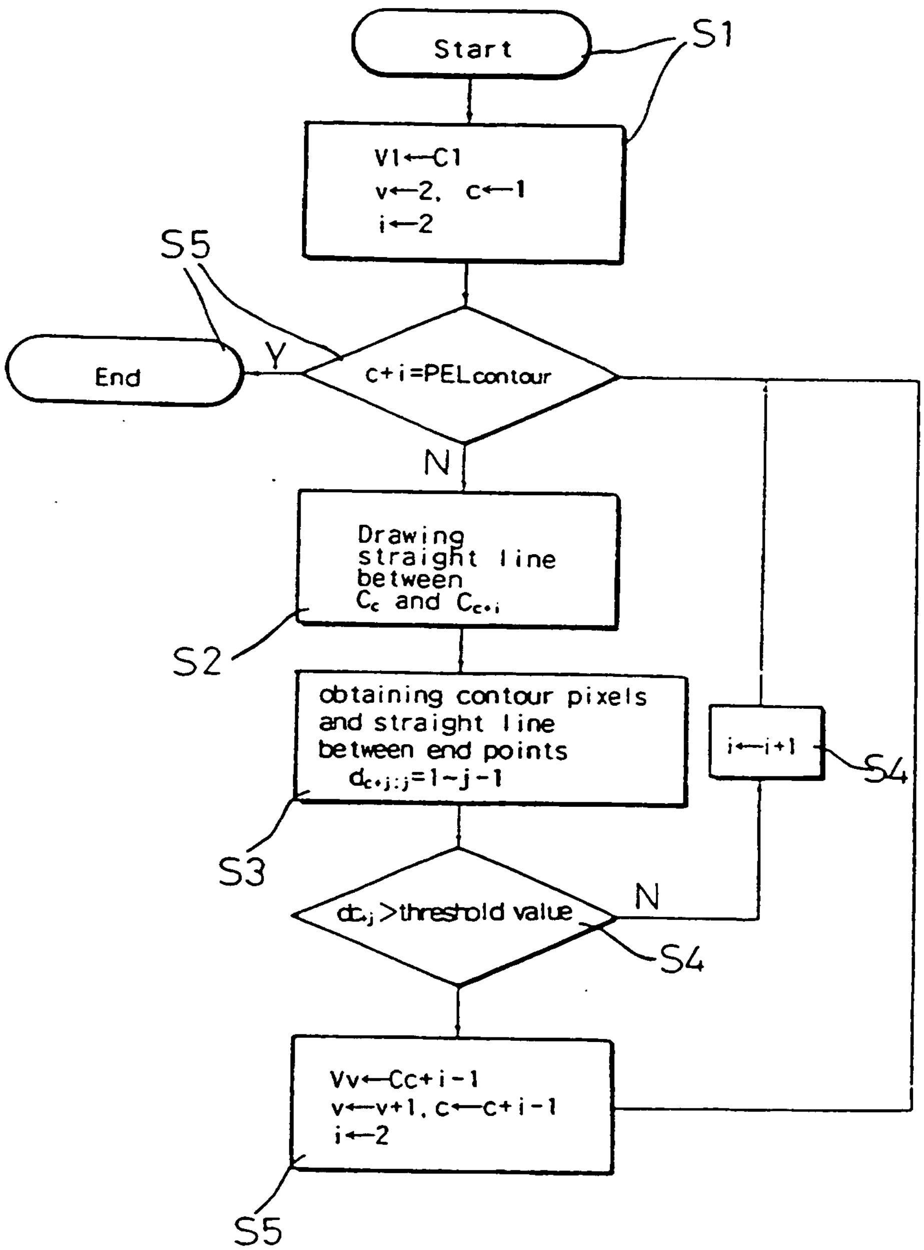
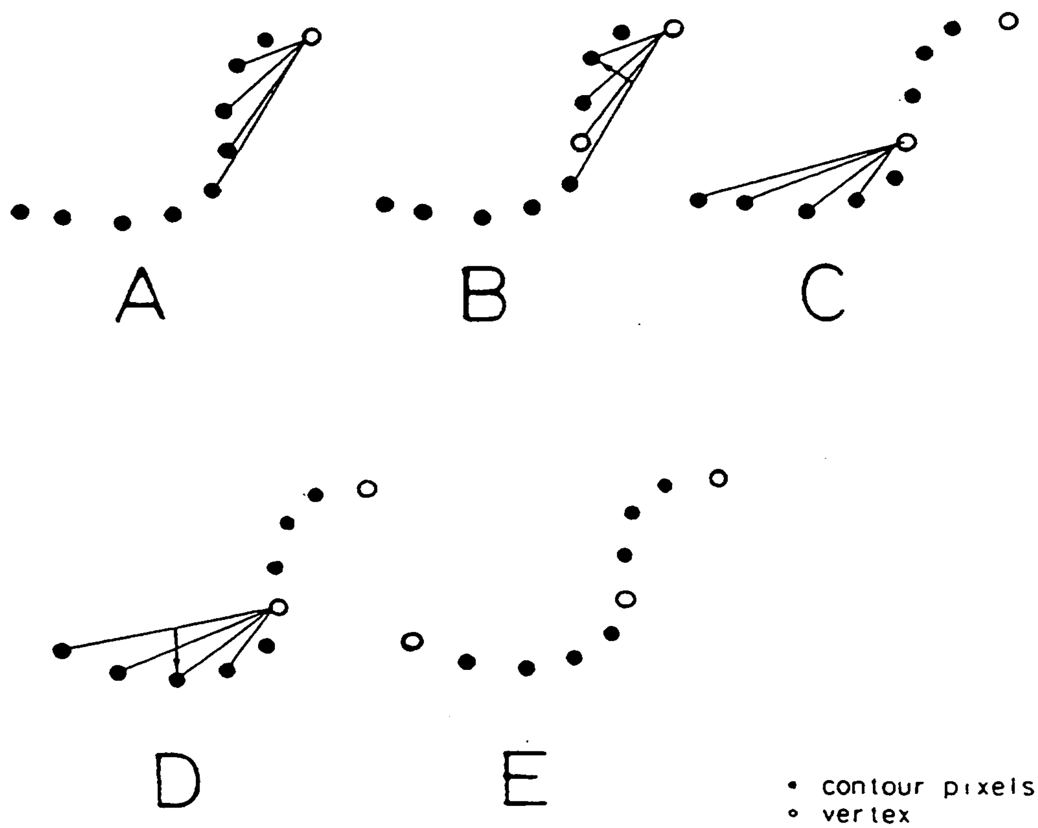

Start
S1
V1←C1
v←2, c←1
i←2
S5
End
Y
c+i=PEL contour
N
Drawing straight line between C_c and C_{c+i}
S2
obtaining contour pixels and straight line between end points
$d_{c+j;j}=1\sim j-1$
S3
i←i+1
S4
$d_{c,j}$>threshold value
N
S4
Vv←Cc+i-1
v←v+1, c←c+i-1
i←2
S5

FIG. 12



SHAPE INFORMATION REDUCTION APPARATUS AND METHOD THEREOF AND ITS SEQUENTIAL POLYGONAL APPROXIMATION METHOD

The present invention relates to a method of and apparatus for shape information reduction, and particularly to a sequential polygonal approximation method capable of predicting movement compensation of an object contour of a series of images, transmitting a prediction error by a prediction error region, and reducing transmitted shape information on an object image.

Conventionally, videophone, teleconference systems, image coding/decoding and computer vision systems require high speed and concentrated data transmission when transmitting/receiving motion picture data. One aspect of motion picture data transfer includes reducing the amount of data when transmitting shape information.

In this regard, M. Hötter introduced a report titled as "Predictive contour coding for an object-oriented analysis-synthesis coder" in IEEE International Symposium Information Theory, San Diego, California, USA, January 1990, at page 75, and P. Gerken disclosed a report titled as "Object-oriented analysis-synthesis at low bit rates" IEEE Transaction on Circuits and System for Video Technology, special Issue on very low-bit rate video coding, Vol 4, No. 3, June 1994, pp228-235.

According to the above-mentioned techniques an entire contour of a moving object image region is approximated, a moving compensation of vertices used in the approximation is predicted, and the error is transmitted. However, when a lot of data is transmitted or received, the resolution of pictures can be deteriorated.

Polygonal approximation, which involves generating an

approximation of a contour of a moving object region, is used in object recognition, object analysis and image coding. To polygonally approximate a contour, in the case of a contour having two end points, the two end points are linked with a straight line as shown in Fig. 1A. A point which has a maximum distance between one point and another point, forming a contour in the vertical direction, is a new vertex. The end points of the contour and the new vertices are linked with a straight line.

Until the maximum distance between contour pixels in the vertical direction with respect to each straight line is smaller than a certain threshold value Dmax, the above-mentioned methods are performed. As a result, a straight line is obtained, as shown in Figs. 1C and 1D.

In addition, in the case of an endless contour, two pixel points having the maximum straight distance between pixel points consisting of a contour are linked, and the above-mentioned methods are performed so as to obtain a desired straight line. The threshold value is the maximum error value with respect to a contour and a straight line in case of polygonally approximating a contour.

However, the polygonal approximation method has a disadvantage in that when the maximum error between polygonal straight line distances is smaller than the threshold value, a desired straight line is not adequately accurately obtained. In addition, the number of vertices is increased due to many polygonal straight line intervals, so that it is difficult to transmit/receive the location information.

It is an object of the present invention to provide shape information reduction apparatus and a method which overcome the problems encountered in conventional shape

information reduction.

It is another object of the present invention to provide improved shape information reduction apparatus and a method thereof and its sequential polygonal approximation method capable of predicting a movement compensation of an object image contour of a series of images, transmitting a prediction error by a prediction error region, and reducing the amount of shape information transmitted for the object.

The present invention is defined in the accompanying independent claims. Some preferred features of the invention are recited in the dependent claims.

To achieve the above objects in one form of the invention there is provided shape information reduction apparatus, which includes a motion compensation prediction unit for predicting shape information of a current frame using shape information of a previous frame and motion information of a current frame in a motion compensation method; a subtracting unit for subtracting shape information motion-compensation-predicted by the motion compensation prediction unit and a current motion region and for computing an isolated prediction error region; a threshold operation unit for performing a threshold operation with respect to the isolated prediction error region obtained by the subtracting unit and for determining transmission and blocking of information in accordance with the threshold operation; a contour approximation coding unit for predicting a contour of a predicted error region determined by the threshold operation unit and for reduction-coding and transmitting the shape information; a contour reformatting unit for reformatting contour coded by the contour approximation coding unit into an isolated prediction error region; and a combining unit for combining the isolated

prediction error region obtained by the contour reformatting unti and a shale information of a moving compensation predicted current frame.

To achieve the above objects according to one procedure there is provided a shape information reduction method, which includes the steps of obtaining a prediction error region using a motion information of a current frame and a contour of a moving-compensated previous frame; extracting a prediction contour and a transmission contour from the transmitted prediction error region and computes the number of pixels; obtaining an evaluation function using the number of pixels of two contours and comparing the evaluation function with a threshold value; when the evaluation function is greater than the threshold value, approximating a transmission contour in a polygonal/spline approximation method which is not performed using a prediction contour because there is an error in extracting a certain object; extracting the maximum error value in a coding method using a prediction contour when the evaluation function is smaller than the threshold value; comparing the extracted maximum error value and the threshold value used in the polygonal/spline approximation; transmitting a certain vertex by adopting a position in which the maximum error occurs and the both ends of the transmission contour as an approximate vertex when the maximum error value as a result of the comparison is greater than the threshold value; and not transmitting a certain region information when the maximum error value is smaller than the threshold value as a result of the comparison.

In a preferable further step, a prediction error region is obtained using motion information of a current frame and a contour of a movement-compensated previous frame;

extracting a prediction contour and a transmission contour from the transmitted prediction error region; extracting a prediction transmission contour from the transmitted prediction error region; linking two neighboring transmission contours within a certain distance into one transmission contour; and approximating in a polygonal/spline method with respect to the linked transmission contours.

Preferably there is provided a shape information reduction sequential polygonal approximation method, which includes the steps of determining a first vertex for starting a polygonal approximation of a certain contour; defining a straight line from the first vertex to the next pixel and computing the distance between the pixel, formed between the straight lines, and the straight line; judging whether the maximum straight distance computed by the second step is greater than the previously set threshold value; linking the vertex and the next pixel with a straight line and computing the distance between a pixel formed between defined straight lines and a straight line when the maximum straight distance computed is smaller than the previously set threshold value; and setting a previous pixel as a new vertex and drawing a straight line between the new vertex and the next pixel and computing the distance between the pixel forming the straight line of the second step and the straight line when the maximum straight distance computed by the judging step is greater than the previously set threshold value.

The present invention can be put into practice in various ways some of which will now be described by way of example with reference to the accompanying drawings in which:

Figs. 1A through 1D are views of a conventional shape polygonal approximation method;

Fig. 2 illustrates conventional shape information reduction;

Fig. 3 illustrates conventional shape information analysis on an object image between a previous frame and a current frame;

Fig. 4 illustrates a conventional movement compensated picture between a previous frame picture and a current frame picture;

Fig. 5 is a block diagram of a shape information reduction apparatus according to the present invention;

Figs. 6A through 6C are views of a polygonal/spline approximation method according to the present invention;

Fig. 7 is a flow chart of a polygonal/spline approximation method according to the present invention;

Figs. 8A through 8C are views showing a linking method of two neighboring contours of Fig. 7 according to the present invention;

Figs. 9A through 9C are views of a polygonal approximation method of a prediction error value using a prediction contour according to the present invention;

Fig. 10 is a flow chart of a moving compensation contour prediction coding method according to the present invention;

Fig. 11 is a flow chart of a sequential polygonal approximation method according to the present invention; and

Figs. 12A through 12E views of a sequential polygonal approximation method according to the present invention.

A shape information reduction apparatus and a method thereof and its sequential polygonal approximation method according to the present invention is directed to

classifying a picture into a changed object region and a background or unchanged region in which the information does not change. The background region does not need information analysis and data transmission. The previous signal is used at a receiving terminal.

Motion picture information is obtained using an object model and a motion model in the region of the extracted motion object region. Motion information and shape information on a moving object region are transmitted to the receiving terminal of the system. The picture is reproduced using a motion compensated prediction, motion information, and shape information on the object region transmitted from the receiving terminal of the system.

The present invention can achieve a better prediction performance compared with a conventional block-oriented coding method because the motion information is predicted according to the moving object, and it is possible to reduce block effects and to improve picture resolution.

Since transmission of shape information is directed to providing different motion information to two neighboring pixels with respect to a boundary between objects, spots, which occur in the block-oriented method, and edge distortions do not occur.

The moving object region can include regions in which motion compensation prediction errors occur, and these regions correspond to regions in which an assumed object model and motion model do not fit. In this regard, the above-mentioned phenomenon take place in a certain region of an object. In the case of a picture in which the object is the human face this is around the eyes or mouth. Since these regions are important parts of the face coding color information so as to effectively reproduce original signals

using a receiving terminal is necessary. When an uncovered background is presented due to a moving object image, certain further information corresponding the region vacated by the moving object should be provided because it is not present in the previously transmitted images.

Fig. 2 shows a background of head and shoulder, a model compliance region, a model failure region, and a uncovered background. The shape information of a moving object region can be expressed in a binary image or a contour which indicates a compliance/failure boundary.

The shape information of a moving object region due to the same object in a series of images has a large amount of repeated information that is redundant on reception. A predictive contour coding method is directed to the above-mentioned method of predicting a contour in a motion compensation method, transmitting a predictive error, and reducing the amount of shape information transmitted.

The contour prediction coding method which is adopted so as to implement the objects of the present invention is directed to a threshold operation for selecting a transmission prediction error so as to transmit shape information or error information according to the region in which a predictive error occurs, and a contour approximation coding. This method has advantages in that it is possible to reduce the transmission rate without picture resolution deterioration and to control cording (recording) parameters compared with a conventional contour prediction coding regime. In addition, the consequential polygonal approximation method adopted in the present invention is directed to determining vertices in order of pixel of given contours. Thus, when the maximum error in a polygonal straight line interval is smaller than the threshold value,

it is possible to obtain gains by reducing the number of vertices and the amount of transmitted data on vertices.

In a motion picture coding operation for an object, the shape information should be transmitted with the highest priority together with motion information for the motion compensation prediction.

The transmission of the shape information provides different motion information to neighbouring pixels and has advantages in preventing spots, which occur during a coding-by-object method, edge distortions, and user-perceived resolution deterioration.

The shape information transmitted is of good quality using a coding-by-object method and is achieved at a low transmission rate. It also has a better user-perceived picture resolution compared with the coding-by-block method.

The method of expressing edge regions uses computer graphics, character recognition, and object synthesis. For example, in the industry, chain difference coding, S-character curves, polygonal approximation and the Fourier description method are well known. However, since these methods are not directed to transmission, when the contour of a moving object region is transmitted frame by frame, it is impossible to actually adopt any of these known methods.

There are many similarities of type and positions between shape information of a moving object region which are present in the same object in a series of frames. Therefore, it is possible to predict current shape information from past shape information. The motion compensation prediction with respect to shape information can be made possible by predicting motion information of a moving object. When the moving object region extraction and the motion information prediction are precise, the

transmission of the shape information is not necessary.

This shape information coding decoding method is called a predictive contour coding method.

Since the transmission rate is reduced, the ratio of the shape information is increased and it is necessary to reduce the amount of transmitted shape information so as to obtain a coding gain compared with coding-by-clock in which the shape information transmission is not necessary.

In this embodiment of the present invention, a threshold operation and a contour approximation method are adopted so as to reduce the amount of shape information, using a selected a transmission prediction error. At this time, in case of predicting a motion compensation of the current shape information, isolated prediction error regions occur.

Fig. 3 shows shape information of an object of a previous frame ("N-1"th frame) and a current frame ("N"th frame), and Fig. 4 shows nine isolated prediction error regions when the shape information of the previous frame ("N-1"th frame) moves according to the motion information, and when the current frame is predicted in a method of motion compensation. Here, the region with respect to the shape information of the current frame for the nine prediction error regions is coded and transmitted.

The prediction error transmission can include certain information which does not influence the clarity of the image as perceived by the user. The information influencing the user-perceived picture resolution is transmitted, and the information which does not influence the resolution is not transmitted, so that a low transmission rate coding can be made.

The present invention is directed to removing the

information, which does not influence the user-oriented picture resolution, through the threshold operation so that the information is not transmitted.

The threshold operation is performed using a region in which a certain error occurs.

The approximation method is adopted for transmitting contour and effectively reducing the shape information so as to transmit a predictive error region to be transmitted.

The contour approximation method includes a polygonal/spline approximation method and a polygonal approximation method which is characterized to approximating the prediction error value.

Fig. 5 shows a motion compensation contour prediction coding apparatus. The apparatus includes a motion compensation prediction unit 16 for predicting motion compensation of current frame shape information using the shape information of a previous frame. A subtracting unit 11 receives the output from the prediction unit 16 to compute a difference value between the output signal and an object region signal corresponding to the current frame. A threshold operation unit 12 receives the output from the subtracting unit N to compute an isolated prediction error region and to perform a threshold operation with respect to the isolated prediction error region. The output of the threshold unit 12 corresponds to information which influences the clarity of the image object to the observer. The threshold unit 12 blocks the transmission of information which does not influence the clarity. A contour approximation coding unit 13 receives teh output from the threshold unit 12. The unit 13 reduces the amount of shape information to be transmitted by adopting an approximation method in transmitting contour so that a transmission

prediction error region is produced based on the threshold unit output. A contour reformatting unit 14 reformats the contour coded by the threshold operation unit 12 and the contour approximation coding unit 13 into a reproducing prediction error region. An addition unit 15 adds the prediction error region isolated by the contour reformatting unit 14 and the output of the motion compensation prediction unit 16, computes shape information of the current frame and for outputs the computed information to the motion compensation prediction unit 16.

The threshold operation unit and the contour approximation coding unit 13 are important elements in this embodiment of the present invention.

The prediction error region of two moving object regions, the threshold operation with respect to the same, and the contour approximation coding for an error region transmission will now be explained.

To begin with, the threshold operation for selecting error information to be transmitted influences the user-perceived resolution and the amount of data transmitted. The threshold operation is directed to adopting characteristics of size and shape of the error region. The shape information of the moving object region and the motion information are extracted from two real pictures. That is, the extracting process on the current picture is independent of the shape information on the previous picture. The extraction of the moving object region and the prediction of the motion information should give improved accuracy for prediction between information on two shapes and it is unnecessary to transmit the shape information.

However, there is a shape information prediction error due to the limitations of the motion information prediction

method and the signal characteristic of the actual images. In addition, the moving object region includes a moving object and a uncovered background. Since this region is devoid of motion information, the motion compensation prediction is impossible and errors can occur.

The prediction error of the shape information may include information which is not germane to the acuity of the human eye because the human eye is sensitive in this regard to geometric shapes and movement of the entire object. Therefore, this embodiment of the present invention is directed to removing the above-mentioned errors through a threshold operation and not to transmitting the errors. The non-transmission of the errors can make an effective contribution to the reduction of transmitted data relating to the user-perceived picture resolution. The threshold operation of the contour prediction coding apparatus according to the present invention is directed to removing minor error information and redundant shape change information.

The contour of the shape information may be seen simply, but it is possible to see more complex changes when detecting the contour by pixels. When the pixel unit difference is performed using binary images of the prediction shape information and the real shape information, error regions having tens or hundreds of pixels are generated due to the shape information, addition and subtraction regions can be generated even though the prediction is accurate. Therefore, it is necessary to remove a smaller error region so as to remove a meaningless error region.

The selection of the threshold value which is necessary to remove the smaller error region is available up to the

maximum value of size of the region in which the acuity of the eye is not sensitive in the entire image. In this regard, it is necessary to preferably set 1~5 PEL (Picture element) or 2~3 PEL.

Therefore, the removal of the smaller error region having a proper threshold value can reduce the transmission rate without influencing the user-oriented picture resolution and can be easily performed by dividing the contour of a moving object into a plurality of independent error regions. The acuity characteristic of the eye is more sensitive to shape and movement of the entire portion of an object rather than position error. Therefore, rapid changes of the shape of an object generated in accordance with a signal characteristic, which is not a region changed by the movement of the object, and a moving object region extraction are not available with respect to the acuity of the eye.

In order to transmit the above-mentioned information, a lot of data is necessary, and it may not be of benefit for the user-perceived picture resolution. Therefore, this shape change information need not be transmitted. The error region which is determined to be transmitted is coded with respect to its contour. The contour of the error region includes a contour (such as a prediction contour) of shape information. The transmission contour in which a prediction contour is removed is transmitted. The transmission data amount is increased when using chain difference coding in which error is not provided in the transmission contour coding as an error region having, for example, a narrow stripe in the head and shoulder of an object image. Therefore, in this embodiment of the present invention, it is necessary to adopt a contour coding method

using an approximation. A partial position error of the contour is used.

However, since the visual acuity of the eye is sensitive to the geometric shape of an object, picture resolution which causes eye strain due to this minor position error can be prevented.

Figs. 6A through 6C show a polygonal/spline approximation process which is used with the above-mentioned contour approximation. The transmission contour 20 of the error region to be transmitted is approximated in a polygonal method as shown in Fig. 6A. The number of vertices of the polygon 30 is dependent on an actual transmission contour 20 and an approximate polygon 30. This approximation level indicates the maximum difference between the actual transmission contour 20 and the approximate polygon 30. Here, when the maximum difference is great, it becomes a coarse approximation, and the number of vertices is decreased, and when the maximum difference is small, it becomes an accurate approximation, and the number of vertices is increased.

As shown in Fig. 6B, a spline 40 passing approximate vertices is obtained, and a distance between each pixel of the spline 40 and the transmission contour 20 is detected. When the distance d1 exceeds the threshold value dmax, as shown in Fig. 6C, the approximate distance including the pixel is approximated by the polygon 20 instead of using the spline 30. When the distance d2 is below the threshold value dmax, the approximate distance including the pixels as shown in Fig. 5C, is approximated by the spline 40.

An index indicating whether the distance between the position of the vertex and the vertices is a polygonal approximation or the approximation is transmitted to the

receiving terminal, so that a polygon/spline is obtained. The contour approximation in which a polygon and a spline are provided shows more natural contours with a smaller number of vertices compared with the polygonal approximation.

The procedure of approximating a plurality of transmission contours using the above-mentioned polygon/spline approximation method will now be explained. After performing the threshold operation, the procedure includes the steps of detecting a transmission contour from an error region to be transmitted, linking two neighboring transmission contours within a certain range and a certain transmission contour, and performing a polygon/spline approximation with respect to the linked transmission contour.

The above-mentioned procedures will now be explained in more detail with reference to Fig. 7. The transmission contour is detected from an error region to be transmitted after a threshold operation (S1). There may occur unnecessary vertices between neighbouring transmission contours. In order to overcome the above-mentioned problems, a step of linking two neighboring contours within a certain range and a certain contour is performed (S2).

In addition, a polygonal/spline approximation is performed with respect to the linked transmission contour (S3).

Figs. 8A through 8C show a procedure of linking two neighboring contours and a certain transmission contour. A shown in Fig. 8A, when two transmission contours are neighbouring, a top approximate vertex of an upper contour and an initial approximate vertex are linked. These are approximated again and one approximate vertex and one

initial vertex are removed, so that it is possible to reduce the transmitted data by this amount.

The conventional contour prediction coding method is directed to approximating the entire contour in a method of a polygon/spline, and to predicting in a motion compensation method using the approximate vertex. However, the polygon/spline approximation method of the present invention is directed to performing an approximation by dividing the entire contour into a plurality of transmission contours. In addition, it is directed to approximating the reduction of the transmission amount by removing a smaller error region and to approximating a plurality of smaller transmission contours.

In addition, it is possible to control the shape information transmission amount using a threshold value which can be given in every transmission contour and a threshold value which is used for a plurality of smaller transmission contours.

Figs. 9A through 9C show a polygonal approximation method of error information using a prediction contour which is another method for approximating a contour. Even though the moving object region extraction is relatively well performed, the prediction contour and the transmission contour in an error region, which occurs due to the problems of motion information prediction, are similar in their shapes. In this case, it is possible to approximate by reformatting a transmission contour using a prediction contour. This method is directed to reducing the number of vertices which are necessary to approximate the transmission contour.

Figs. 9A through 9C show an approximate process using a prediction contour. Fig. 9A shows an approximation process

with respect to a transmission contour 5' of an error region E which occurs due to a motion information prediction rather than due to the moving object region prediction. As shown in Fig. 9B, an error of the transmission contour 5' and the prediction contour 52 is obtained, and the error amount is reformatted based on an index of the prediction contour 52, so that the information with respect to the transmission contour 51 is not lost, and it is possible to change the transmission contour 5' of Fig. 9A into a contour 53 having a smaller curvature radius. The contour of Fig. 9B is approximated into a plurality of vertices as shown in Fig. 9C.

It is possible to obtain an appearance contour which is made by approximating the transmission contour 5' by adding the approximated transmission contour 54 to the prediction contour 52 in the original image frame. This method is directed to reducing the necessity of a spline approximation for a more natural appearance because the appearance contour is dependent on a prediction contour.

The threshold operation as shown in Fig. 5 has a region in which approximation is well performed and a region in which approximation is not well performed based on a contour prediction error region in an entire portion of one frame. At this time, another approximation method can be adopted with respect to each region, which includes the steps of obtaining the number of pixels by detecting a transmission contour and a prediction contour, judging whether an object extraction has a desired region using the number of two contours, coding a transmission contour using a polygon/spline approximation method when it is not a desired region, i.e. the object extraction is not well performed, extracting the maximum error value using a polygonal

approximation method of error information using a prediction contour when a region is well object-extracted, judging whether the extracted maximum error value is greater than the threshold value dmax used in the polygonal/spline approximation, and approximating a position in which the maximum error occurs and both ends of a transmission contour as an approximate vertex when the maximum error value is greater than the threshold value dmax and transmits three vertices.

The above-mentioned steps will now be explained in more detail with reference to Fig. 10.

To begin with, a transmission contour and a prediction contour are detected from the transmission error region, and the number of pixels are obtained (S1). The region in which the object extraction is performed is judged using the number of pixels of the detected two contours (S2). At this time, an evaluation function D which is a judging reference is obtained by the following expression.

$$D = \frac{|NT - NP|}{(NT - NP)/2}$$

where NT denotes the number of transmission contours, and NP denotes the number of prediction contours.

In the region in which the object extraction is not well performed, the difference between two pixels is great, and the evaluation function D is increased.

When the threshold value is given and the evaluation function D to be transmitted is greater than the threshold value Dth, it is judged that there is a problem in the object extraction. The polygonal/spline approximation method, which does not consider the prediction contour, is then adopted to code the transmission contour (S3).

When the evaluation function D of the error region is smaller than the threshold value Dth, a coding method is adopted using a prediction contour, which includes a step which extracts the maximum error value MAX ERROR (S4), and a step which judges whether the extracted maximum error value is greater than the threshold value dmax adopted in the polygon/spline approximation (S5).

The region in which the maximum error value MAX ERROR is smaller than the threshold value dmax is not transmitted since the approximate error is small. In this regard, an error region having a long stripe corresponds to this. When the maximum error value MAX ERROR is greater than the threshold value dmax, the position in which the maximum error occurs and both ends of the transmission contour are approximated as an approximate vertex, three vertices are transmitted (S6). The transmission contour coding method using a prediction contour does not include a step of combining neighbouring error regions so as to maintain a uniformity of an error characteristic compared with the polygonal/spline approximation method.

When vertices indicating both ends of two neighbouring transmission contours are close, two vertices are represented as one vertex, and an index corresponding to it is transmitted.

In addition, a polygonal approximation method of error information using a contour has an advantage in that a transmission reduction and a spline approximation are not performed by approximating three vertices at each transmission contour compared with the conventional method.

Fig. 11 shows a flow chart of a sequential polygonal approximation method according to the present invention, which includes the steps of: detecting a contour to start a

polygonal approximation and selecting one of two pixels in the case of a contour having two ends and determining the selected pixel as a first vertex, and selecting a certain pixel in the case of an endless contour and determining the selected pixel as a first vertex (that is, V1<-C1, v<-1, I<-12: Cn denotes nth contour pixel or its position, and Vn denotes nth vertex or its position); a second step of linking a straight line between the pixel Cc determined at the first vertex (Cth) of the first step and the contour pixel C(c+1) of the third step (S1); a third step of computing a straight line distance (d(c+j). j=1~i-1 which is the distance between dn and Cn) of the contour pixels provided between the both ends Cc and C(c+1) formed by the second step; a fourth step (S4) of judging whether the maximum distance between the straight distances (d(c+j) obtained by the third step is greater than the threshold value dmax, and selecting the next pixel (i<-i+1) when the maximum distance is not greater than the threshold value and performs from the second step again, and a fifth step (S5) of determining the just previous pixel as a new vertex when the maximum distance between the straight lines (d(c+j) obtained by the third step is greater than the threshold value (Vv<-C(c+i-1), v<-v+1, c<-c+i-1, I<-2) and performing from the second step (S2) based on a reference of the vertex and ends the operation when the total number of the contour to be polygonal-approximated (c+i=PEL contour : PEL contour : the total number of the contour to be approximated).

When a contour is given as shown in Fig. 12, the pixel of the contour to be polygonal-approximated is detected.

At this time, when the given contour is a contour having two ends, one of two pixels is selected and, in the case of the endless contour, a certain contour of which is

selected. The selected one pixel becomes a first vertex.

Next, the first vertex and the third vertex are linked by a straight line, and the straight line distance between the contour pixels (here, it is referred to as the second contour pixel) presented between both ends of the straight line (here, it is referred to as the first and third contour pixels), and it is judged that whether the maximum distance of the straight line is greater than the given threshold value.

When the maximum distance is smaller than the given threshold value, as shown in Fig. 12A, the first pixel and the fourth pixel are linked by the straight line, and the straight line distance between the obtained straight line and the contour pixels (here, the second contour pixel and the third contour pixel) presented between the both ends (here, it is referred to the first contour pixel and the fourth contour pixel).

When the above-mentioned operation is performed many times, and the straight line is linked between the nth pixels, when the maximum distance of the straight line is greater than the threshold value as shown in Fig. 12B, the n-1th pixel becomes a new vertex as shown in Fig. 12C, and the above-mentioned process is performed until the contour is completed as shown in Figs. 12D and 12E.

The number of vertices of the polygonal approximation of the present invention is decreased compared with the number of vertices which is determined by the conventional polygonal approximation method because the maximum distance of an actual contour in all of the polygonal straight interval is the threshold value. In particular, when the position information of a vertex is transmitted in the video coding, since the number of vertexes is decreased, a coding

gain can be achieved.

When the threshold value of the number of vertexes (not the value of the threshold value) is given, the polygonal approximation process is performed until the number of vertexes can fit to the certain number. Therefore, the objects of the present invention can be achieved more easily in the polygonal approximation method.

Meanwhile, for the polygonal approximation, two threshold values are available. One of which is an effective maximum distance dmax between the actual contour and the polygonal straight line, and the other of which is the number of vertices. The former is directed to controlling an accuracy of the approximate polygonal and the latter is directed to more easily controlling the data amount.

When coding the shape information of an object, since this information is more important in its visual feature, the accuracy is more important than the number of vertexes. In this regard, the polygonal approximation method can achieve a high coding gain compared with the conventional method since the threshold value is given.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as described in the accompanying claims.

CLAIMS:

1. A shape information reduction method by object for video instruments, comprising the steps of:

a first step which obtains a prediction error region using a motion information of a current frame and a contour of a moving-compensated previous frame;

a second step which extracts a prediction contour and a transmission contour from the transmitted prediction error region and computes the number of pixels;

a third step which obtains an evaluation function using the number of pixels of two contours and compares said evaluation function with a threshold value;

a fourth step which, when the evaluation function is greater than the threshold value, approximate a transmission contour in a polygonal/spline approximation method which is not performed using a prediction contour because there is an error in extracting a certain object;

a fifth step which extracts the maximum error value in a coding method using a prediction contour when the evaluation function is smaller than the threshold value;

a sixth step which compares the extracted maximum error value and the threshold value used in the polygonal/spline approximation;

a seventh step which transmits a certain vertex by adopting a position in which the maximum error occurs and the both ends of the transmission contour as an approximate vertex when the maximum error value as a result of the comparison is greater than the threshold value; and

an eighth step which does not transmit a certain region information when the maximum error value is smaller than the threshold value as a result of the comparison.

2. The method of claim 1, wherein said shape information reduction method by object further includes a step which is directed to motion-compensation-predicting a contour using a redundancy presented between shape information of a motion region with respect to the same object in a series of images and to transmitting a prediction error by region in which said prediction error occurred and to reducing the shape information transmission amount.

3. The method of claim 1, wherein said shape information reduction method by object further includes a step which is directed to dividing a contour of a moving object into independent error regions when motion-compensation-predicting a shape information of a previous frame along a motion information and a current frame in accordance with a motion information and to coding and transmitting a shape information with respect to a prediction error region.

4. The method of claim 3, wherein said shape information reduction method by object further includes a step which is directed to coding and transmitting a certain part corresponding to a shape information of a current frame with respect to a prediction error region.

5. The method of claim 1, wherein said shape information reduction method by object further includes a step which is directed to obtaining an error size with respect to a prediction contour so as to approximate a transmission contour and to polygonally approximating said error information and to expressing the approximate error in

a frame with respect to the prediction contour.

6. The method of claim 5, wherein said shape information reduction method by object further includes a step which is directed to computing a difference of a transmission contour in a state that the error size is obtained and to obtaining an actual error value having a smaller curvature and to approximating a contour based on the obtained error value.

7. The method of claim 6, wherein said shape information reduction method by object further includes a step which is directed to adopting a polygonal approximation method so as to approximate the same error size.

8. The method of claim 6, wherein said error size approximation method is directed to transmitting error information with three vertexes in a polygonal approximation of an error information using a position in which the maximum error occurs and both ends of a transmission contour as an approximation vertex.

9. The method of claim 8, wherein said shape information reduction method by object further includes a step which is directed to combining an approximation error to a prediction contour in a receiving terminal and reproducing a contour in a certain frame.

10. The method of any of claims 1 to 9, wherein said shape information reduction method by object further includes a step which is directed to approximating a contour by dividing a well extracted region and a not well extracted

region in case of approximating a transmission contour with respect to the entire frame.

11. The method in any of claims 1 to 10, wherein said shape information reduction method by object further includes an evaluation function D of:

$$D = \frac{|NT - NP|}{(NT - NP)/2}$$

where NT denotes the number of transmission contours, and NP denotes the number of prediction contours.

12. The method in any of claims 1 to 11, wherein said shape information reduction method by object further includes a step which is directed to transmitting an index indicating one vertex representing of two vertexes when a vertex indicating both ends two neighboring transmission contour neighbors in case of computing a certain vertex and transmitting the vertex.

13. A method as claimed in any of claims 1 to 12, further comprising the steps of:

a ninth step which obtains a prediction error region using a motion information of a current frame and a contour of a moving-compensated previous frame;

a tenth step which extracts a prediction contour and a transmission contour from the transmitted prediction error region;

an eleventh step which extracts a prediction transmission contour from the transmitted prediction error region;

a twelfth step which links two neighbouring

transmission contours within a certain distance into one transmission contour; and

a thirteenth step which approximates in a polygonal/spline method with respect to the linked transmission contour.

14. The method of claim 13, wherein said twelfth step is directed to linking the end approximate vertex of an upper contour and an initial vertex of a lower contour when two contours neighbors and performing an approximation and reducing one approximation and one vertex.

15. A shape information reduction apparatus for video image, comprising:

motion compensation prediction means for predicting shape information of a current frame using shape information of a previous frame and motion information of a current frame in a motion compensation method;

subtracting means for subtracting shape information motion-compensation-predicted by the motion compensation prediction means and a current motion region and for computing an isolated prediction error region;

threshold operation means for performing a threshold operation with respect to the isolated prediction error region obtained by the subtracting means and for determining transmission or blocking of information;

contour approximation coding means for predicting a contour of a predicted error region determined by said threshold operation means and for reduction-coding and transmitting the shape information;

contour reformatting means for reformatting a contour coded by said contour approximation coding means into an

isolated prediction error region; and

combining means for combining the isolated prediction error region obtained by said contour reformatting means and scale information of a moving compensation predicted current frame.

16. The apparatus of claim 15, wherein said threshold operation means is directed to removing a region including information which is not sensitive to human eyes with respect to a prediction error of shape information through a threshold operation in consideration of a visual characteristic which is sensitive to a geometric shape of the object and its movement.

17. The apparatus of claim 15, wherein said threshold operation means is directed to obtaining the difference of pixel units using two binary images of prediction shape information and actual shape information and generating an error region having a plurality of pixels and removing an error region which alternatively appears in combining and subtracting regions in a region having a narrow contour.

18. The apparatus of claim 15, wherein said threshold operation means is directed to removing a minor error region corresponding to the maximum value of a region size which is not visually sensitive in the entire images and reducing transmission rate unless it is affected with respect to a user-oriented picture resolution.

19. The apparatus of claim 15, wherein said threshold operation is directed to blocking transmission of redundant shape information due to a signal characteristic which is

not changed by a movement of an object, due to a certain characteristic on a visual sensitivity with respect to the entire shape of the object and movement of the same rather than the position of the object, and a rapid change of an object shape type which is generated in accordance with a motion region extraction.

20. The apparatus of any of claims 15 to 19, wherein said contour approximating coding means is directed to removing a prediction contour contained in a contour of an error region and coding a transmission contour.

21. The apparatus of any of claims 15 to 20, wherein said contour prediction means is directed to approximating a transmission contour obtained by the threshold operation means using a difference coding.

22. The apparatus of claim 21, wherein said contour prediction means is directed to approximating a transmission contour obtained by the threshold operation means using a difference coding.

23. A shape information reduction polygonal approximation method for a video image, comprising the steps of:

a first step which determines a first vertex for starting a polygonal approximation of a contour;

a second step which defines a straight line from the first vertex to the next pixel and computes the distance between the pixel, formed between the straight lines, and the straight line;

a third step which determineswhether the maximum

straight distance computed by said second step is greater than the previously set threshold value;

a fourth step which links the vertex and the next pixel with a straight line and computes the distance between a pixel formed between straight lines of the second step and a straight line when the maximum straight distance computed by the third step is smaller than the previously set threshold value; and

a fifth step which sets a previous pixel as a new vertex and defines a straight line between the new vertex and the next pixel and computes the distance between the pixel formed the straight line of the second step and the straight line when the maximum straight distance computed by the third step is greater than the previously set threshold value.

24. The method of claim 23, wherein said first stage is directed to determining one of both ends as the first vertex when a given contour has two ends.

25. The method of claim 23, wherein said first step is directed to determining a certain pixel of pixels consisting of a contour as the first vertex when a given contour is an endless type.

26. The method of claim 23, wherein said threshold value is determined by the effective maximum distance between an actual contour and a polygonal straight line.

27. The method of claim 23, wherein said threshold value is given as the number of vertices.

28. A method of coding shape change information for a video image, the method comprising:

determining an error region of the image in which a variation in the image has occurred using image motion information from a current frame of video information and image contour position information from a previous frame;

deriving a predicted contour and a transmission contour from the error region and computing the number of pixels therein;

performing an evaluation function on the number of pixels of the two contours;

comparing the result of the evaluation with a first threshold value;

approximating a transmission contour according to a polygonal/spline approximation method when the said result is greater than the threshold value;

deriving a maximum error value according to a coding method when the said result is less than the threshold value;

comparing the extracted maximum error value with a second threshold value;

reducing for transmission first vertex information coincident with a position of the maximum error value and second vertex information on both ends of the transmission contour when the maximum error value is greater than the second threshold value.

29. A method of decoding shape change information for a video image coded according to the method of claim 29, the method comprising:

receiving the first and second vertex information; and

modifying the image of the previous frame in accordance

with the decoded information.

30. Apparatus for coding shape change information for a video image, the apparatus comprising:

means for determining an error region of the image in which a variation in the image has occurred using image motion information from a current frame of video information and image contour position information from a previous frame;

means for deriving a predicted contour and a transmission contour from the error region and computing the number of pixels therein;

means for performing an evaluation function on the number of pixels of the two contours;

means for comparing the result of the evaluation with a first threshold value;

means for approximating a transmission contour according to a polygonal/spline approximation method when the said result is greater than the threshold value;

means for deriving a maximum error value according to a coding method when the said result is less than the threshold value;

means for comparing the extracted maximum error value with a second threshold value;

means for reducing for transmission first vertex information coincident with a position of the maximum error value and second vertex information on both ends of the transmission contour when the maximum error value is greater than the second threshold value.

31. Apparatus for decoding shape change information encoded with the apparatus of claim 30, the apparatus

comprising:

means for receiving the first and second vertex information; and

means for modifying the image of the previous frame in accordance with the decoded information.